

Datasheet – TEC Controller TEC-1163 ($\pm 25\text{ A}$ / $\pm 56\text{ V}$)



Support / First steps

Meerstetter Engineering provides technical support for all products and helps you to integrate a product into your solution. Most of your questions should be solved by reading the provided [user manuals](#) of the corresponding product or the [FAQ](#) (frequently asked questions).

For further help or if you have any other questions, please do not hesitate to contact us. We are happy to help you. You can contact us by email support@meerstetter.ch.

Meerstetter's product family compatibility

The Meerstetter LDD and TEC-Family have been developed to work along with each other. They share the same platform bus, communication protocol and hardware architecture. See Table for an Overview over the LDD- and TEC-Families.

| LDD-Family | | |
|------------------------------|---|---|
| LDD-1321 | 0-1.5 A / 0-14 V | CW, Add on TEC Controller available |
| LDD-1301 | 0-20 A / 0.5-45 V | 1 ms - CW |
| LDD-1303 | 0-20 A / 1-120 V | 1 ms - CW |
| LDD-1137 | 0-75 A / 0-70 V | 0.5 μs - CW, modulated, QCW and pulsed modes |
| LDD-1124-SV | 0-1.5 A / 0-15 V | 1 μs - CW, modulated, QCW and pulsed modes |
| LDD-1121-SV | 0-15 A / 0-15 V | 1 μs - CW, modulated, QCW and pulsed modes |
| LDD-1125-HV | 0-30 A / 0-27 V | 1 μs - CW, modulated, QCW and pulsed modes |
| TEC-Family | | |
| TEC-1092 | $\pm 1.2\text{ A}$ / $\pm 9.6\text{ V}$ | Micro, single channel |
| TEC-1091 | $\pm 4\text{ A}$ / $\pm 21\text{ V}$ | Small, single channel |
| TEC-1089-SV | $\pm 10\text{ A}$ / $\pm 21\text{ V}$ | Medium, single channel |
| TEC-1162 | $\pm 5\text{ A}$ / $\pm 56\text{ V}$ | Medium-high, single channel |
| TEC-1090-HV | $\pm 16\text{ A}$ / $\pm 30\text{ V}$ | Large, single channel |
| TEC-1163 | $\pm 25\text{ A}$ / $\pm 56\text{ V}$ | Extra-large, single channel |
| TEC-1161-4A | 2 x ($\pm 4\text{ A}$ / $\pm 21\text{ V}$) | Small, dual channel |
| TEC-1161-10A | 2 x ($\pm 10\text{ A}$ / $\pm 21\text{ V}$) | Medium, dual channel |
| TEC-1122-SV | 2 x ($\pm 10\text{ A}$ / $\pm 21\text{ V}$) | Medium, dual channel |
| TEC-1166 | 2 x ($\pm 5\text{ A}$ / $\pm 56\text{ V}$) | Medium-high, dual channel |
| TEC-1123-HV | 2 x ($\pm 16\text{ A}$ / $\pm 30\text{ V}$) | Large, dual channel |
| TEC-1167 | 2 x ($\pm 25\text{ A}$ / $\pm 56\text{ V}$) | Extra-large, dual channel |

One Channel OEM TEC Controller



Description:

The TEC-1163 is a specialized TEC Controller/power supply able to precision-drive one Peltier element.

- It features a true bipolar DC current source for cooling / heating, three temperature monitoring inputs (1x high resolution, 2x low resolution) and intelligent PID control with auto tuning. The TEC-1163 is fully digitally controlled, it's hard- and firmware offer numerous communication and safety options.
- The included PC-Software allows configuration, control, monitoring and live diagnosis of the TEC Controller via USB, RS232 TTL and RS485. All parameters are saved to non-volatile memory. Saving can be disabled for bus operation.
- For the most straightforward applications, only a power supply, a Peltier element and at least one temperature sensor need to be connected to the TEC-1163. After power-up the unit will operate according to pre-configured values. (In stand-alone mode no control interface is needed.)
- The TEC-1163 can handle either Pt100, Pt1000, NTC or Voltage temperature probes. For highest precision and stability applications a Pt100 / 4-wire input configuration is recommended. Analog measurement circuit is factory calibrated.
- Auxiliary temperature inputs allow the connection of NTC probes that are located on the heat sinks of the Peltier elements. This additional data is used to compensate for parasitic thermal conduction of Peltier elements. Also, it allows the control of external heat sink cooling fans.

- The heating and cooling power is optimized by proprietary thermal management routines based on power balance models (for Peltier elements and resistive heaters).
- Further functionality includes: Smooth temperature ramping, thermal stability indication and auto gain (NTC probes). The PC-Software allows data logging and configuration import/export.

Features

Input Characteristics:

- DC Input Voltage: 11.5 to 63 V

Output Characteristics:

- Voltage: up to ± 56 V
- Current: up to ± 25 A

Main Features:

- Temperature Sensor Types: Pt100, Pt1000, NTC, Voltage
- Temperature Precision / Stability: < 0.01 °C
- Temperature Control & Measurement Frequency: 1 Hz, 10 Hz, 90 Hz
- Communication bus compatible
- Configuration and monitoring with Service Software

Operation Modes:

- Stand-alone operation
- Remote-controlled over USB, RS485, RS232 TTL, CANopen CiA 301, I/O
- Script-controlled over lookup table (thermal cycling)

Driver Modes:

- DC power supply (bipolar)
- Temperature control: PID settings, auto tuning, optional cool/heat-only or resistor heating modes

Important Note:

The following features will be activated with an incoming firmware update, but are not yet useable:

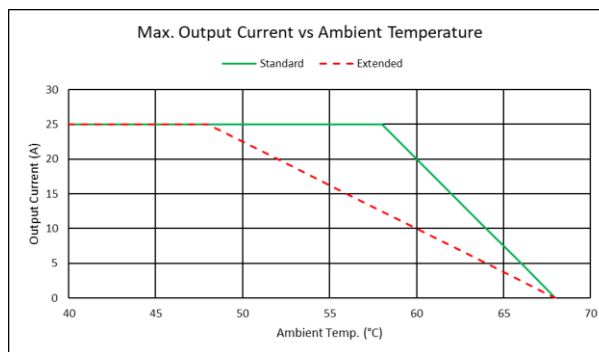
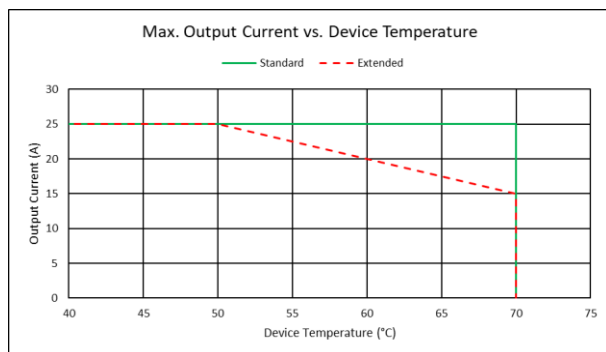
- GPIO9 and GPIO10
- Low-resolution temp. measurement input 3

General Characteristics

| Absolute Maximum Ratings | |
|--------------------------|-----|
| Supply voltage (DC) | 70V |

| Operating Ratings | |
|-------------------|----------------------------|
| Temperature | -40 – 70°C |
| Humidity | 5 – 95 % non-condensing |

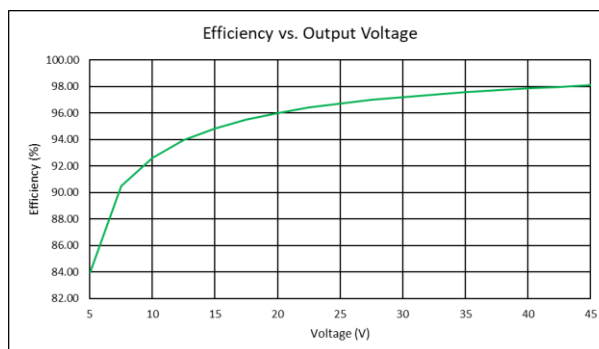
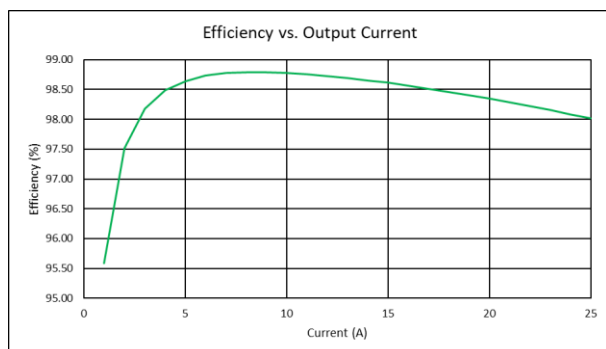
Operating Characteristics



Note:

Standard or Extended Device Temperature Mode can be set as software setting.
No forced air flow was present.

Efficiency



Note:

The Efficiency measurements were done at 48 V input voltage, an output voltage of 44 V, an output current of 25 A and a base plate temperature of 60°C unless otherwise noted. The ambient temperature was 23°C, no forced air flow was present.

Electrical Characteristics

Unless otherwise noted: $T_A = 25^\circ\text{C}$, $U_{IN} = 48$ V

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--|-----------------------|---|------|-----|----------|-------|
| DC Power Supply Input: | | | | | | |
| U_{IN} | Supply voltage | | 11.5 | | 63 | V |
| U_{IN} Ripple | Ripple tolerance | U_{IN} never below U_{IN} min or above U_{IN} max | | | 300 | mVPP |
| Output: | | | | | | |
| I_{OUT} | Bipolar current swing | | | | ± 25 | A |
| U_{OUT} | Bipolar voltage swing | U_{OUT} is maximum $\sim 0.90 U_{IN}$ | | | ± 56 | V |
| U_{OUT} Ripple | Voltage ripple | @ 25 A | | | 120 | mVPP |
| System Characteristics: | | | | | | |
| $\eta_{50\%}$ | Power efficiency | @ 50% load (28 V, 25 A) | | 93 | | % |
| $\eta_{100\%}$ | Power efficiency | @ 100% load (56 V, 25 A) | | 95 | | % |
| Output Monitoring (I_{OUT} Resolution is 18.3 mA; U_{OUT} Resolution is 17.6 mV): | | | | | | |
| I_{OUT} Read | Precision | @ 24 A | | 1 | 5 | % |
| U_{OUT} Read | Precision | @ 30.0 V | | 1 | 3 | % |

Output Safety Characteristics

Unless otherwise noted: $T_A = 25^\circ\text{C}$, $U_{IN} = 48$ V

| Symbol | Parameter | Test Conditions / Hints | Min | Typ | Max | Units |
|--|-----------------|----------------------------|-----|-----|-----|---------------|
| Output Stage Protection Delays: | | | | | | |
| t_{OFF} short circuit | | Full load condition | | 10 | 30 | μs |
| t_{OFF} power system limits | | Current and voltage limits | | | 200 | μs |
| Output Stage Current Supervision: | | | | | | |
| (If the $OUT+$ and $OUT-$ currents differ too much, an error is generated) | | | | | | |
| I_{OUT_DIFF} | Error threshold | | | 2.5 | | A |

High Resolution Temperature Measurement Characteristics (NTC Probes)

NTC thermistor resistive input characteristics translate into temperature ranges valid for only one type of NTC probe. Below example is given in the case of an NTC B25/100 3988K R25 10k temperature sensor.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-----------------|-------------------------------------|-----------------|----------------|-----|-----|------------------|
| $R_{HR, RANGE}$ | ADC auto gain PGA = 1 or 8 or 32 | | 73 | | 1 M | Ω |
| | | | 194.3 to -55.5 | | | $^\circ\text{C}$ |

$ROBJ, RANGE$ is resistance range of the NTC sensor.

High Resolution Temperature Measurement Characteristics (Pt100 and Pt1000 Probes)

Measurement configuration = 23 bit / 4-wire / unshielded cable <50 mm

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-------------------------|-------------------|--|------|-----|------|-------|
| T _{OBJ, RANGE} | Range | Range is extendable upon request. Extended measurement range is -193 °C ... +787 °C | -220 | | +200 | °C |
| T _{OBJ, PREC} | Precision | (EN 60751 / IEC 751) | | 5 | | mK |
| T _{OBJ, COEFF} | Temp. coefficient | Relative to device temperature | | | 1.6 | mK/K |
| T _{OBJ, NOISE} | Value noise | Reference measurement fluctuations while output stage operating @ 70 % load | | 5 | | mK |
| T _{OBJ, REP} | Repeatability | Repeated measurements of reference resistors after up to 3 days | | 8 | | mK |

High Resolution Temperature Measurement Configuration (Voltage Measurement VIN1/2)

Sensors with linear Voltage/Temperature output.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-------------------------|-----------|--|--------|-----|-------|-------|
| V _{SENS, DIFF} | Range | Differential input voltage Temperature range depends on sensor used | -2.039 | | 2.039 | V |
| T _{OBJ, RANGE} | Range | Absolute input voltage | -0.1 | | 5.1 | V |

Low Resolution Temperature Measurement Characteristics (NTC only)

T_A = 25 °C, measurement configuration = 12 bit / 2-wire / unshielded cable <50 mm, °T probe = NTC B25/100 3988K R25 10k

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|------------------------|-----------|---------------------------------|------------|-----|--------|-------|
| R _{LR, RANGE} | Range | Corresponding temperature range | 83 | | 182413 | Ω |
| | | | -30 to 187 | | | °C |

General Purpose Digital I/O Characteristics (GPIO1 ... GPIO10)

Unless otherwise noted: T_A = 25 °C

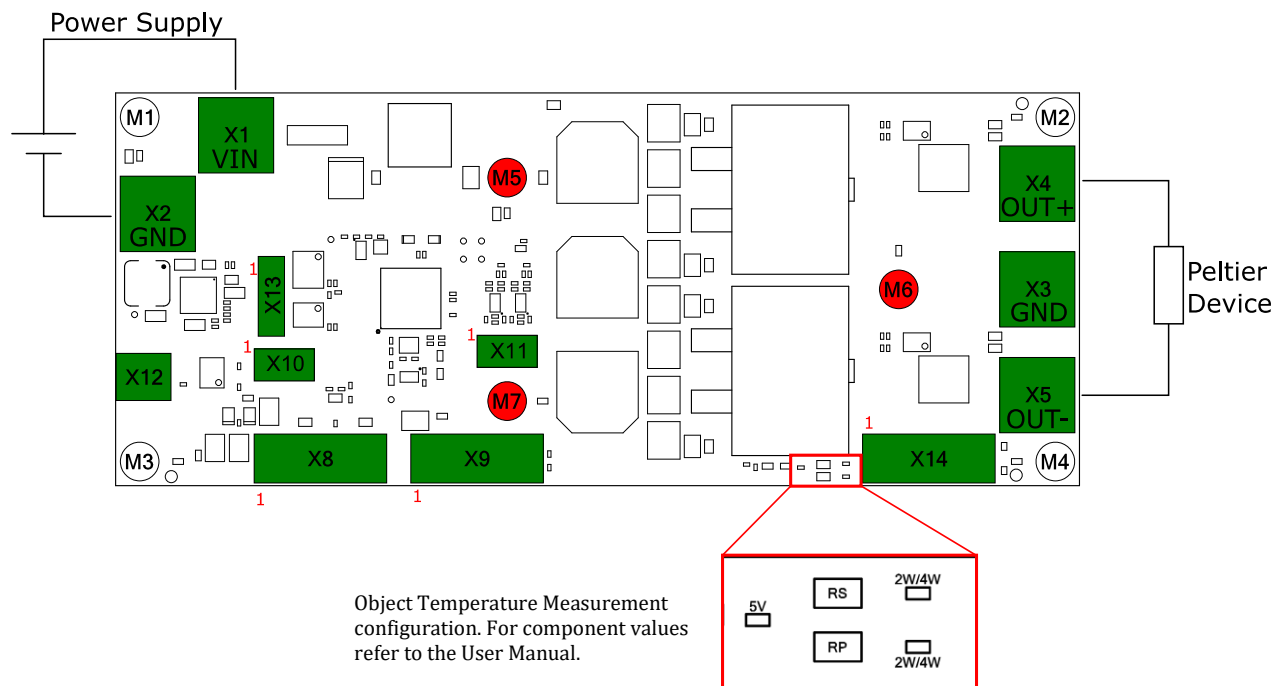
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-----------------------------------|-------------------------------|---------------------|------|-----|------|-------|
| Input Characteristics: | | | | | | |
| (Microprocessor) | | | | | | |
| U _{IH} | Logic high input threshold | | 2.38 | | | V |
| U _{IL} | Logic low input threshold | | | | 0.93 | V |
| U _{IMAX} | Maximum input voltage | | -0.5 | | 5.5 | V |
| Output Characteristics: | | | | | | |
| (Microprocessor) | | | | | | |
| U _{OH} | Logic high output voltage | Output current 8 mA | 2.8 | | 3.3 | V |
| U _{OL} | Logic low output voltage | Input current 8 mA | | | 0.4 | V |
| Z _{OUT} | Output impedance | | | 50 | | Ω |
| I _{OUT} | Output sink or source current | | | ±8 | ±20 | mA |
| ESD Protection: | | | | | | |
| (Between Processor and Connector) | | | | | | |
| U _{PP} | ESD discharge | IEC61000-4-2 | | 18 | | kV |
| | Series resistance | | 85 | 100 | 115 | Ω |

Auxiliary Connector X8, X9, X10 Power Supply Output Characteristics

Unless otherwise noted: $T_A = 25^\circ\text{C}$

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|-------------------------------|-----------------------|--|------|-----|-----|-------|
| Input Characteristics: | | | | | | |
| U_{OUT} | Output voltage | Output current 50mA | 4.4 | 4.5 | 5 | V |
| I_{OUT} | Output current | Sum of output currents of X8, X9 and X10 | 0 | 150 | 200 | mA |
| U_{IMAX} | Maximum input voltage | | -0.5 | | 5.5 | V |

PCB-Overview



Connector X1 - X5

| Parameter | Min | Typ | Max | Units |
|-------------------|-----|------|-----|-------|
| Matching screw | | M4x6 | | |
| Tightening torque | | 2.2 | | Nm |

Connector X8, X9, X14 TB (Terminal Block) version

Matching Receptacle: Würth WR-TBL Series 382. Würth Part Number 691381000008. Pin 1 is marked in red.

| Parameter | Min | Typ | Max | Units |
|----------------|-----|-----|-----|-----------------|
| Wire thickness | 0.2 | | 1.5 | mm ² |

For pinout description: see next paragraph.

Connector X8, X9, X14 CON version

Matching Receptacle: Molex Nano-Fit. Molex Part Number 1053071208. Pin 1 is marked in red.

| Pinout Com Connector X8 (TB and CON version) | | | |
|--|--------------|-------|--------------|
| PIN 1 | +5V | PIN 5 | RS232 TTL TX |
| PIN 2 | GND | PIN 6 | RS232 TTL RX |
| PIN 3 | RS485 1 A/D+ | PIN 7 | CAN1 H |
| PIN 4 | RS485 1 B/D- | PIN 8 | CAN1 L |

| Pinout GPIO Connector X9 (TB and CON version) | | | |
|---|--------|-------|--------|
| PIN 1 | +5V | PIN 5 | GPIO 3 |
| PIN 2 | GND | PIN 6 | GPIO 4 |
| PIN 3 | GPIO 1 | PIN 7 | GPIO 5 |
| PIN 4 | GPIO 2 | PIN 8 | GPIO 6 |

| Pinout Temp Measurement Connector X14 (TB and CON version) | | | |
|--|------------|-------|-------------|
| PIN 1 | HR Temp IA | PIN 5 | LR Temp 1 A |
| PIN 2 | HR Temp IB | PIN 6 | LR Temp 1 B |
| PIN 3 | HR Temp UA | PIN 7 | LR Temp 3 A |

| | | | |
|-------|------------|-------|-------------|
| PIN 4 | HR Temp UB | PIN 8 | LR Temp 3 B |
|-------|------------|-------|-------------|

Connector X10, X11

Matching Receptacle: Würth Mini Module. Würth Part Number 690157000472. Pin 1 is marked in red.

| Pinout Aux Com Connector X10 | | | |
|------------------------------|-----|-------|--------------------------------|
| PIN 1 | +5V | PIN 3 | CAN2 H (CAN2 is not available) |
| PIN 2 | GND | PIN 4 | CAN2 L (CAN2 is not available) |

| Pinout Aux GPIO Connector X11 | | | |
|-------------------------------|--------|-------|---------|
| PIN 1 | GPIO 7 | PIN 3 | GPIO 9 |
| PIN 2 | GPIO 8 | PIN 4 | GPIO 10 |

Connector Specifications X12

The Mini USB Connector X12 can be used to communicate with the TEC Controller using the meCom communications protocol or the Service Software. It is electrically isolated.

Connector Specifications X13

The Connector X13 can be used to connect one of the OLED Displays available from Meerstetter (DPY-1113, DPY-1114 or DPY-1115)

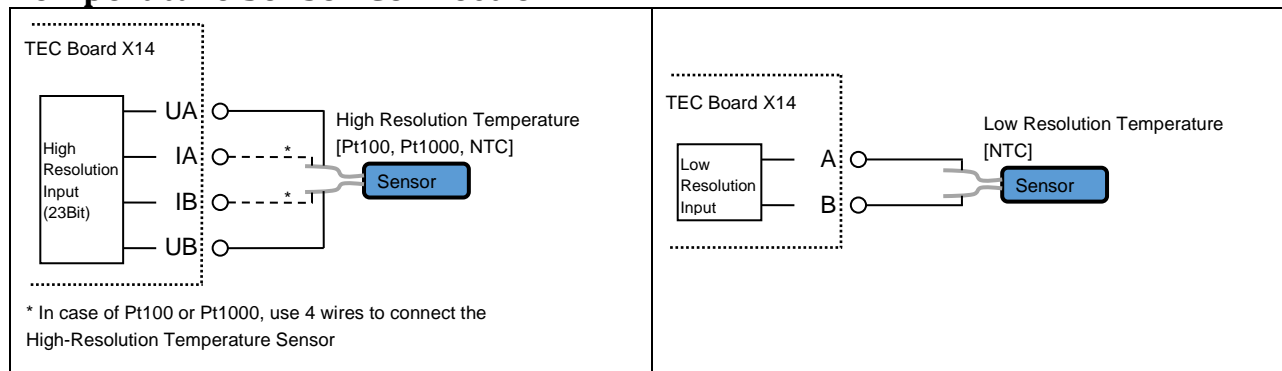
Temperature Measurement Configuration

The Jumpers "2W/4W" are used for the 2 Wire / 4 Wire configuration. For the values of RS and RP please refer to the TEC Controller User Manual.

Mounting Holes M1 - M7

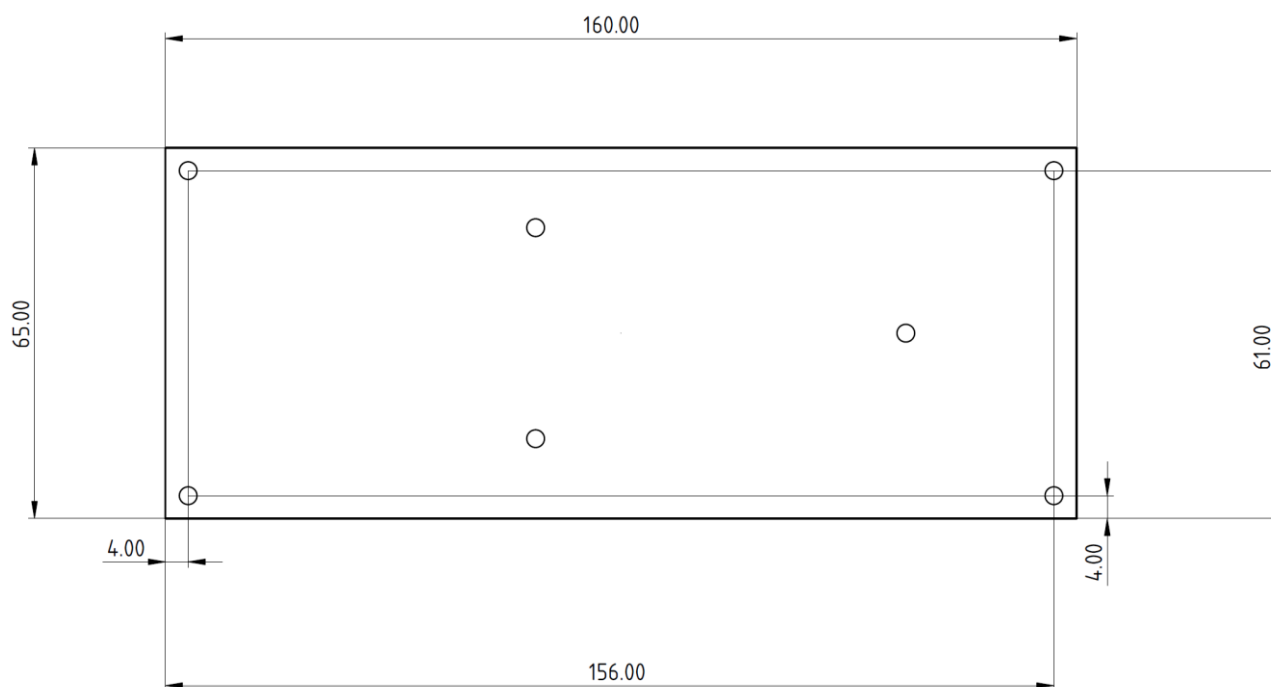
All Mounting holes have a Diameter of 3.05mm. Holes M5-M7 (Marked in red) are used to mount the aluminum base plate to the device and should not be removed.

Temperature Sensor Connection X14



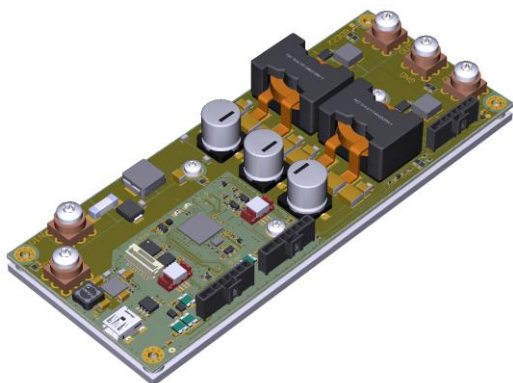
Dimensions and Mounting Hole Positions

Top View, all measurements in mm.

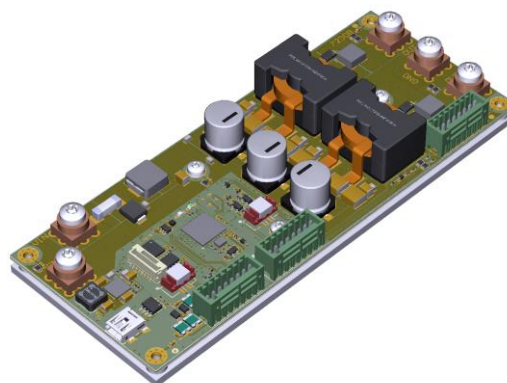


Operation-Modes / Theory of Operation

The TEC-1163 is an OEM precision TEC Controller that is available with Terminal Blocks and with connectors. Its basic operation status is visually indicated by on-board green and red LEDs and their blinking pattern.



CON locking Connector equipped version
(Best suited for series production)



TB Terminal Block equipped version
(Best suited for prototyping, commissioning and small series.
Attention: Counter parts for Terminal Blocks will not be shipped with the device!)

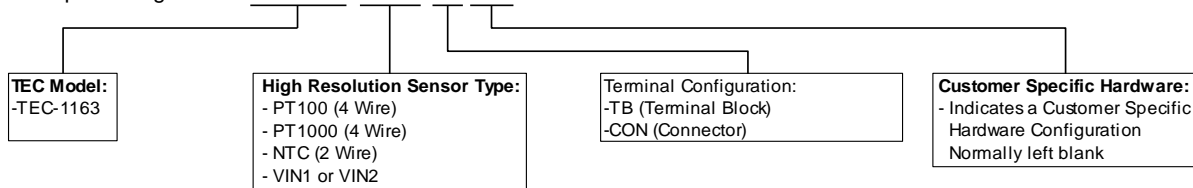
Status information can be polled at any time by industry standard connections RS485, RS232 TTL, CANopen or by USB. The TEC-1163 can also operate in a remotely controlled manner, with parameters adjusted on the fly. The TEC Controller has Scripting capability by sequential lookup table read-out.

Configured as a DC power-supply, the TEC-1163 can handle current and voltage settings. In the remote-control case, temperature data may be passed on to be processed by the host.

Configurable parameters further include sensor linearization (Pt100 / Pt1000) and Steinhart-Hart modeling (NTC), temperature acquisition hardware calibration, Peltier element modeling, PID controller auto tuning, nominal temperature ramping, current, voltage and temperature limits, error thresholds, etc. Please refer to the TEC Controller User Manual (Document 5216) for further information.

TEC-1163 Ordering Information, Hardware Configuration

Example Configuration: **TEC-1163-PT100-TB-CSX**



High Resolution Sensor Type:

Thermocouple: To use our TEC Controller with thermocouples type K, you need a CI-1181 in addition to the TEC Controller with a VIN1 Object Sensor Type configuration.

Meerstetter Engineering
GmbH
Schulhausgasse 12
3113 Rubigen, Switzerland

Meerstetter Engineering GmbH (ME) reserves the right to make changes without further notice to the product described herein. Information furnished by ME is believed to be accurate and reliable. However typical parameters can vary depending on the application and actual performance may vary over time. All operating parameters must be validated by the customer under actual application conditions.

Annex A. Change history

| Date of change | Doc/V ersion | Changed/ Approved | Change / Reason |
|------------------|-----------------|----------------------|------------------|
| 6 July 2023 | A | HS / ML | Document Created |
| 13 December 2023 | B | LS / MR | Add front page |